

RESEARCH PAPER

A review of *Lasioglossum* (*Leuchalictus*) in Taiwan (Hymenoptera: Apoidea: Halictidae)

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Abstract. The Taiwanese bee species of the subgenus *Leuchalictus* Warncke, 1975 of the genus *Lasioglossum* Curtis, 1833 are revised. Three species are recognised, *Lasioglossum formosae* (Strand, 1910), *Lasioglossum subopacum subopacum* (Smith, 1853), and one new species, *L. subinoum* sp. nov., which was formerly misidentified as *L. inoum* (Cameron, 1904). *Lasioglossum formosae* is redescribed based on the topotypic specimens. It is concluded that *L. occidentis* (Smith, 1873) is not distributed in Taiwan. A key to the Taiwanese species is provided, and the distribution of all species is mapped.

Key words. Hymenoptera, Apoidea, Halictidae, bees, distributional map, key to species, new species, redescription, Oriental Region

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Introduction

The bee genus *Lasioglossum* Curtis, 1833 (Halictidae: Halictinae) includes approximately 1,800 species worldwide (ASCHER & PICKERING 2023), distributed on all continents except for Greenland, Iceland, some Arctic islands, and Antarctica (PACKER 2023). It is also classified into two higher categories (MICHENER 2000, 2007): the *Hemihalictus* series includes all subgenera with a weak 1r-m vein of the female fore wing; the *Lasioglossum* series includes all subgenera with a strong 1r-m vein of the female fore wing. Adding the recent phylogenetic and taxonomic studies (DANFORTH & JI 2001; DANFORTH et al. 2004, 2008; GIBBS 2018; GIBBS et al. 2012, 2013; PAULY et al. 2012, 2013; ZHANG et al. 2022), the systematic of *Lasioglossum* modified from MICHENER (2000, 2007) is as follows: the *Hemihalictus* series includes *Acanthalictus* Cockerell, 1924, *Austrevylaeus* Michener, 1965, *Capalictus* Pauly, Gibbs & Kuhlmann, 2012, *Dialictus* Robertson, 1902, *Eickwortia* McGinley, 1999, *Evylaeus* Robertson, 1902, *Hemihalictus* Cockerell, 1897, *Habralictellus* Moure & Hurd, 1982, *Paradialictus* Pauly, 1984, *Rostrohalictus* Warncke, 1975, and *Sphcodogastra* Ashmead, 1899; the *Lasioglossum* series includes *Australictus* Michener, 1965, *Callalictus* Michener, 1965, *Chilalictus* Michener, 1965, *Ctenonomia* Cameron, 1903, *Glossalictus* Michener, 1965, *Homalictus* Cockerell, 1919, *Ipomalictus* Pauly, 1999,

Lasioglossum s. str., *Leuchalictus* Warncke, 1975, *Papualictus* Michener, 1980, *Parachilalictus* Pauly, Walker, Munzinger & Donovan, 2013, *Parasphecodes* Smith, 1853, *Pseudochilalictus* Michener, 1965, *Quasilictus* Walker, 1986, *Rubrihalictus* Pauly, 1999, and *Urohalictus* Michener, 1980. *Lasioglossum* is similar to *Halictus* Latreille, 1804 in the tribe Halictini Thomson, 1869. It is separated from *Halictus* by the female fore wing with at least 2r-m and 2m-cu veins weakened and metasomal terga without plumose apical hair bands (rarely with thin plumose apical hair bands). Furthermore, this group is recognized for its diverse social structures, including solitary, parasocial, and primitively eusocial, etc. (e.g., MICHENER 1974).

A total of 34 *Lasioglossum* species have been either described or recorded from Taiwan (STRAND 1910, 1913, 1914; COCKERELL 1911; BLÜTHGEN 1924, 1926a; YASUMATSU & HIRASHIMA 1965; EBMER 1996; MURAO & TADAUCHI 2007; MURAO 2015; MURAO et al. 2015b, 2020). A revision of the subgenus *Dialictus* Robertson, 1902 has been recently published (MURAO et al. 2015b). However, the *Lasioglossum* fauna in Taiwan remains uncertain due to the presence of numerous undescribed or unidentified species. In an effort to shed light on this challenging group in Taiwan, we have commenced a study of the subgenus *Leuchalictus* Warncke, 1975.



Leuchalictus currently comprises approximately 40 species distributed worldwide (ASCHER & PICKERING 2023). The social structure of most species is unknown, but several species have been reported to be basically solitary (SAKAGAMI et al. 1966; MIYANAGA et al. 1998, 2000, 2012; MAETA et al. 2001; PACKER 1998; PESENKO et al. 2000). Four species of this subgenus have been recorded from Taiwan so far, namely *Lasioglossum formosae* (Strand, 1910), *L. inoum* (Cameron, 1904), *L. occidens* (Smith, 1873), and *L. subopacum subopacum* (Smith, 1853) (COCKERELL 1911, YASUMATSU & HIRASHIMA 1965, and MURAO 2015).

In this paper, we confirm that there are only three *Lasioglossum* (*Leuchalictus*) species present in Taiwan, including a new species that is described herein. *Lasioglossum formosae* is also redescribed based on the specimens from Taiwan because the original description was insufficient. Diagnostic characters and distribution maps for the three Taiwanese species are illustrated and provided. Additionally, a key is also provided to assist with the identification of all Taiwanese *Leuchalictus* species.

Material and method

Collection. The specimens examined in this study were deposited in the following institutions and personal collections, which are referred to by the following abbreviations:

cMur	private collection of Ryuki Muraio, Fukuoka, Japan;
ELKU	Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka, Japan;
TFRI	Forest Arthropoda Collection of Taiwan, Taiwan Forestry Research Institute, Taipei, Taiwan.

Terminology. Terminology and style used in the description follows MURAO et al. (2015b). Abbreviations used in the text are as follows:

AOD	antennocular distance (shortest distance between outer margin of antennal socket and inner margin of compound eye);
BL	body length (from antennal base to tip of pygidial plate);
CAL	clypealveolar distance (between lower margin of antennal socket and lower margin of supraclipeus in frontal view);
CPL	clypeal length (between upper and lower margins of clypeus in frontal view);
EL	eye length;
EW	eye width (maximum width of the compound eye);
Fn	n-th antennal flagellomere;
FnL	length of n-th flagellomere (measured along the ventral surface);
FnW	width of n-th flagellomere (measured from dorsal to ventral surface of the flagellomere);
GW	genal width (maximum width of the genal area when seen in lateral view);
HL	head length (from top of vertex to lower margin of clypeus);
HW	head width (between outer margins of compound eyes in frontal view);
IAD	interantennal distance (between inner margins of antennal socket);
IOD	interocellar distance (between lateral ocelli);
IS	interspace between punctures (e.g., IS 0.5d means 1/2 of the diameter of a puncture);
LOD	lower interorbital distance;
MNL	metanotal length;
MOD	maximum interorbital distance;
MPL	metapostnotal length;
MsW	maximum mesosomal width;

MtW	maximum metasomal width;
OCD	ocelloccipital distance (shortest distance between upper margins of lateral ocellus and vertex when seen in upper view);
OOD	ocelloccular distance (shortest distance between lateral ocellus and inner margin of compound eye);
PP	punctures;
SCL	mesoscutellar length;
Sn	n-th metasomal sternum;
SPL	antennal scape length (straight line from base to tip of scape);
Tn	n-th metasomal tergum;
UOD	upper interorbital distance;
WL	wing length (length of fore wing from the apical point to the base including tegula).

Images. Most images shown in the illustrations were taken with a Nikon D800 SLR digital camera connected to a Micro-Nikkor 105 mm f/2.8 lens or, if more than 2× magnification, to a special Macro-Nikkor 35 mm f/4.5 lens via a Nikon PB-4 bellow. All images were image-stacked using Helicon Focus software (Helicon Soft Ltd.), then manipulated and edited as illustrative plates by Adobe Photoshop and Illustrator CS6 (Adobe Inc.).

Distribution maps. For each species, we also provide a distribution map based on geo-referenced material. Historical specimens that lacked both the latitude and longitude of recorded locations were geocoded using Google Earth (Google Inc.) and GeoNames (<https://www.geonames.org/>). We also used the niche-modelling software Maxent ver. 3.4.3 (PHILLIPS et al. 2020) to predict the geographical ranges of species beyond those indicated by observational records. For the analysis in Maxent, we used the data of the following six environmental parameters obtained from WorldClim (FICK & HIJMANS 2017): 1) annual mean temperature (BIO1), 2) isothermality (BIO3), 3) temperature seasonality (BIO4), 4) temperature annual range (BIO7), 5) annual precipitation (BIO12), and 6) elevation. These data were processed using QGIS ver. 3.16 (QGIS DEVELOPMENT TEAM 2023).

Taxonomy

Genus *Lasioglossum* Curtis, 1833 Subgenus *Leuchalictus* Warncke, 1975

Leuchalictus Warncke, 1975: 98, as subgenus of *Halictus* Latreille, 1804. Type species: *Apis leucozonias* Schrank, 1781, by original designation.
Bluethgenia Pesenko, 1986: 136, as subgenus of *Lasioglossum* Curtis, 1833. Type species: *Halictus dynastes* Bingham, 1898, by original designation.
Sericohalictus Pesenko, 1986: 137, as subgenus of *Lasioglossum* Curtis, 1833. Type species: *Halictus subopacus* Smith, 1853, by original designation.

Diagnosis. This subgenus is separated from the other subgenera of *Lasioglossum* series occurring in eastern Asia, i.e. *Ctenonomia* Cameron, 1903, *Homalictus* Cockerell, 1919 and *Lasioglossum* s. str., by the combination of the following characters: 1) body black, without metallic luster; 2) inner hind tibial spur of female serrate as in Figs 4A, 8A, 12A; 3) metasomal terga rounded from dorsal to ventrolateral parts; 4) male S6 with unique hair tuft as in Figs 3E, 7E, 11F; and 5) male genitalia without ventral retrorse lobe as in Figs 4D, 12D (MURAO et al. 2015a).

***Lasioglossum (Leuchalictus) formosae* (Strand, 1910)**

(Figs 1A–B, 2–5)

Halictus formosae Strand, 1910: 189. Holotype: ♂ (coll. Museum für Naturkunde, Berlin, Germany). Type locality: Kanshirei, Formosa (Taiwan).

Halictus formosae: STRAND (1914): 152–153 [♀].

Lasioglossum (Lasioglossum) formosae: EBMER (1978): 309; EBMER & MAETA (1999): 238–239, 244–245 [♀♂, photograph].

Lasioglossum (Leuchalictus) formosae: PESENKO (1986): 143 [in key]; PESENKO (2006): 140 [in key], 141 [♂, illustration], 143 [♂, illustration], 145 [in key], 153; MURAO et al. (2015a): 522–524 [photograph], 531 [in key].

Halictus recognitus Cockerell, 1911: 664 [in key], 665. Syntypes: ♀ (coll. Museum für Naturkunde, Berlin, Germany). Type locality: Taihanroku, Formosa (Taiwan). Synonymy by BLÜTHGEN (1922: 63).

Type material examined. *Halictus formosae*: ♂ (coll. Museum für Naturkunde, Berlin, Germany) with three labels as follows: 8. 6. 08, Formosa, Kanshirei, Sauter S. V. (pale yellow rectangle with typed and handwritten text); Type (red rectangle with typed text); *Hal. formosae* n. sp., Strand det. (white rectangle with typed and handwritten text).

Additional material examined. **TAIWAN: TAIPEI CITY:** 1 ♂, Ching-tien Temple, 17.xi.2015, S. S. Lu (TFRI, 00197659); 1 ♂, Kueitzukeng, 19.vi.2014, S. S. Lu (TFRI, 00181080); 1 ♀, Mt. Siaoguanyin, 16.ix.2014, S. S. Lu (TFRI, 00197209); 1 ♀ 1 ♂, Sanyuan st., 3.xi.2017, W. C. Yeh (TFRI, 00198117, 00198118); 2 ♀♀, Taihoku (now Taipei), 20.ix.1927, K. Sato (ELKU); 1 ♂, Taipei, Botanical Garden, 18.vi.2020, W. C. Yeh (TFRI); 1 ♂, ditto, 21.xi.2022, W. C. Yeh (TFRI); 1 ♀ 1 ♂, Tianxiyuan EEC, 20.vii.2012, S. S. Lu (TFRI, 00198250, 00198251); 1 ♀, ditto, 8.vii.2011, S. S. Lu (TFRI, 00116006); 2 ♂♂, Hakuto (Hokuto? now Peito), 20.v.1929, K. Sato (ELKU). **NEW TAIPEI CITY:** 1 ♀, Bayan, 2.xi.2011, S. S. Lu (TFRI, 00166028), 1 ♀, ditto, 28.viii.2013, S. S. Lu (TFRI, 00173317); 1 ♀, Zhonghe Park, 1.iii.2020, W. C. Yeh (TFRI); 1 ♂, ditto, 14.vi.2020, W. C. Yeh (TFRI); 1 ♀, Laomei, 5.xi.2002, W. C. Yeh (TFRI, 00094406); 1 ♀, Wulai, alt. 358 m, 24.8408344, 121.5339089, 31.iii.2018, R. Murao (eMur); 1 ♂, Xinxian, 27.viii.2013, S. S. Lu (TFRI, 00173155). **HSINCHU COUNTY:** 1 ♀, Qingcaohu, 14.vi.2012, W. C. Yeh (TFRI, 00173186). **MIAOLI COUNTY:** 1 ♀, Yongxing Shitan, 25.ix.2015, S. S. Lu & W. C. Yeh (TFRI, 00196718). **TAICHUNG CITY:** 1 ♂, Kukuan (Guguan), 23.x.1976, Sk. Yamane (ELKU); 3 ♂♂, ditto, 750 m, 28.iv.1980, Sk. Yamane (ELKU). **NANTOU COUNTY:** 1 ♀ 1 ♂, Nanshan-chi, 6.v.1965, T. Shirouzu (ELKU); 1 ♂, ditto, 11.v.1980, Sk. Yamane (ELKU); 1 ♀, Hori (now Puli), 27.x.1929, K. Sato (ELKU); 1 ♀, Puli, 8.vii.1966, T. Tano (ELKU); 1 ♂, ditto, 13.vii.1966, T. Tano (ELKU); 1 ♀ 1 ♂, ditto, 4.v.1980, Sk. Yamane (ELKU); 1 ♀, ditto, 7.x.1976 (ELKU); 1 ♂, Penpuchi, 12.v.1980, Sk. Yamane (ELKU). **CHANGHU COUNTY:** 4 ♀♀ 1 ♂, Chiushe, 8.v.1980, Sk. Yamane (ELKU). **CHIAYI COUNTY:** 1 ♀, Fenchihu, 22.vii.1966, T. Tano (ELKU); 1 ♀ 1 ♂, Chunchi, 13.iv.1965, Y. Hirashima (ELKU); 1 ♀, ditto, 20.vii.1965, T. Tano (ELKU); 1 ♀, Zhongpu, 25.iii.2014, S. S. Lu (TFRI, 00196223). **KAOSIUNG CITY:** 1 ♀, Tsai Tie Ku, near Liu Kui, 6.x.1986, K. Baba (ELKU). **PINGTUNG COUNTY:** 1 ♂, Heito (Takaoshu), 8.v.1934, R. Yamaho (ELKU); 1 ♂, ditto, 1933, R. Yamaho (ELKU); 1 ♀, Pintung, 8.ix.1984, K. Kitamura (ELKU); 1 ♀, ditto, 10.x.1984, K. Kitamura (ELKU). **YILAN COUNTY:** 1 ♀, Fushan BG., 18.iv.2017, W. C. Yeh (TFRI, 00196889); 1 ♀, Suao, 19.x.1976, Sk. Yamane (ELKU); 1 ♂, Shikikun-Toganoo (Taihoku-shu), 21.vii.1932, T. Esaki (ELKU). **HUALIEN COUNTY:** 1 ♀, Beipu, 16.iii.1994, S. S. Lu (TFRI, 00072330); 1 ♀, ditto, 7.vi.1994, S. S. Lu (TFRI, 00026657); 2 ♀♀ 1 ♂, Hung Yah, 16.xi.1976, Sk. Yamane (ELKU); 2 ♀♀ 1 ♂, Juisui, 2.v.1980, Sk. Yamane (ELKU); 1 ♂, ditto, 1.v.1980, Sk. Yamane (ELKU); 1 ♂, Wenshan, 21.x.1976, Sk. Yamane (ELKU). **KINMEN COUNTY:** 1 ♀, Caicuo, Jinsha, 14.viii.2015, S. S. Lu (TFRI, 00197325); 1 ♂, Gao-keng, 2.x.2014, S. S. Lu (TFRI, 00178701); 1 ♂, Houpanshan, Kinmen County, 2.x.2014, W. C. Yeh (TFRI, 00178770); 1 ♀, Kinmen Botanical Garden, 13.viii.2015, S. S. Lu (TFRI, 00197640); 1 ♂, Xiancuo, Jincheng, 30.ix.2014, S. S. Lu & W. C. Yeh (TFRI, 00196102); 1 ♀ 1 ♂, Yingkeng, 1.x.2014, S. S. Lu & W. C. Yeh (TFRI, 00196117, 00196119). **PENGHU COUNTY:** 1 ♂, Magong, 22.x.2014, S. S. Lu (TFRI, 00178751); 1 ♂, Tong-liang Park, Baisha, 24.x.2014, S. S. Lu (TFRI, 00178788). **UNCERTAIN:** 3 ♀♀ 2 ♂♂, Jiushe, 11.xi.1972, Sk. Yamane (ELKU).

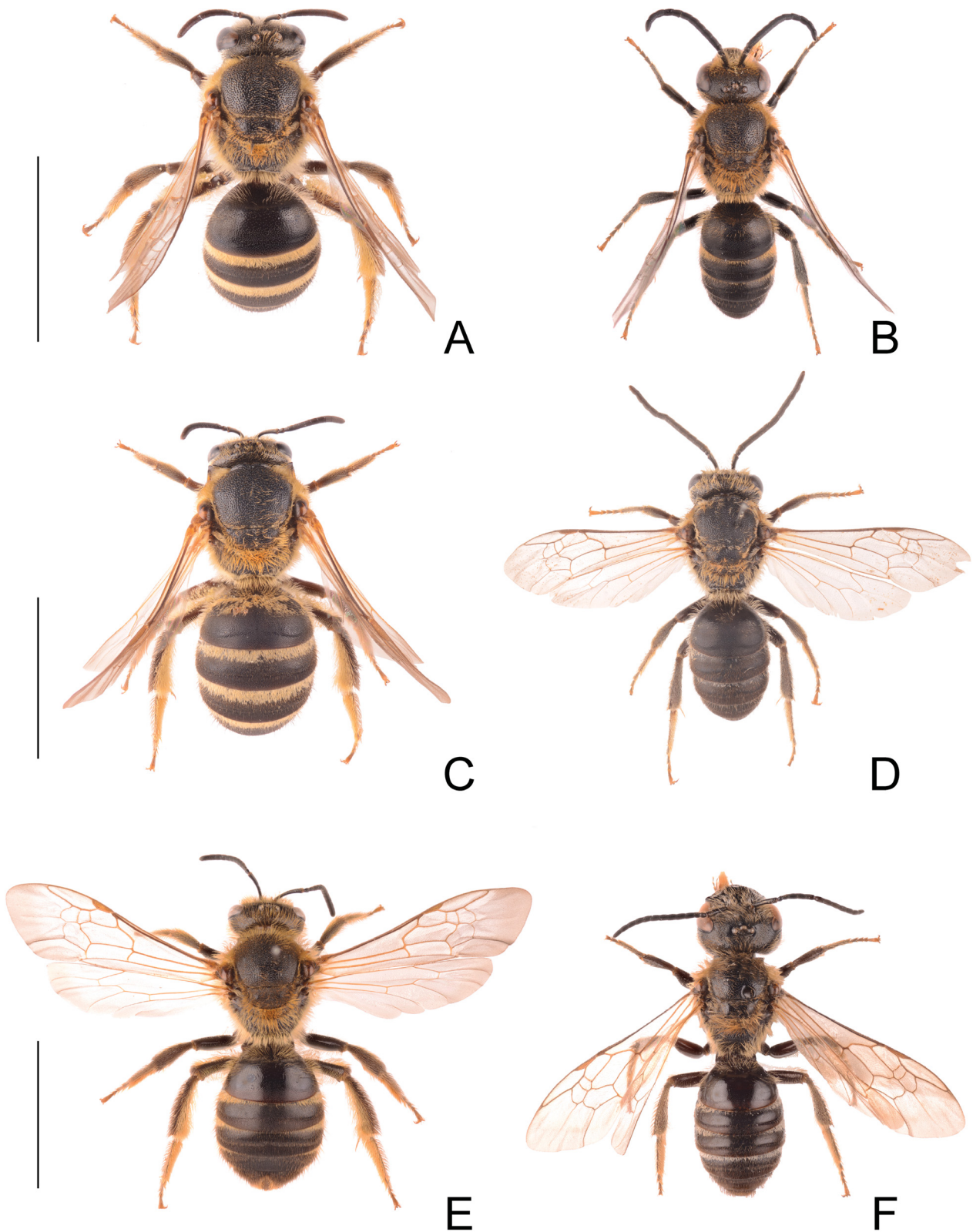
Diagnosis. This species is similar to *Lasioglossum circularum* Fan & Ebmer, 1992 and *L. occidens* from eastern Asia. According to MURAO et al. (2015a), *L. formosae* is separated from *L. circularum* by the IS of female mesoscutum nearly smooth over the entire surface, the lateral and posterior surfaces of female propodeum covered with sparse tomentose, and the hair tuft on male S6 thick apically (Fig. 3E). From *L. occidens* it differs in the lateral and oblique carinae of the posterior surface of female propodeum weakly developed (MURAO et al. 2015a: 6B) and the submedial patch of T1 with denser PP (IS = 2 d maximum) in both sexes (MURAO et al. 2015a: Fig. 6D). In contrast, in *L. circularum* the integument of female mesoscutum is distinctly tessellate, the lateral and posterior surfaces of female propodeum are covered with dense tomentose, and the tuft of hairs on male S6 is narrow apically (MURAO et al. 2015a: Fig. 7A). In *L. occidens*, the lateral and oblique carinae of the posterior surface of female propodeum are strongly developed (MURAO et al. 2015a: Fig. 6A) and the submedial patch of T1 with sparser PP (IS = 3.5 d maximum) in both sexes (MURAO et al. 2015a: Fig. 6C).

Redescription of female. Measurements (in mm; minimum–maximum (mean ± standard deviation; n = 5). BL = 7.23–9.08 (8.37±0.64), WL = 6.00–7.43 (6.71±0.49), HL = 1.97–2.32 (2.20±0.12), HW = 2.06–2.48 (2.29±0.14), IOD = 0.41–0.46 (0.43±0.01), OOD = 0.33–0.39 (0.37±0.02), OCD = 0.30–0.41 (0.37±0.05), UOD = 1.28–1.50 (1.42±0.08), MOD = 1.43–1.78 (1.66±0.12), LOD = 1.13–1.41 (1.28±0.09), IAD = 0.22–0.24 (0.22±0.01), AOD = 0.39–0.48 (0.42±0.03), CAL = 0.37–0.43 (0.41±0.03), CPL = 0.43–0.54 (0.50±0.04), EL = 1.43–1.68 (1.61±0.10), EW = 0.54–0.63 (0.62±0.04), GW = 0.44–0.54 (0.50±0.03), SPL = 0.87–1.04 (0.95±0.06), F1L = 0.11–0.13 (0.12±0.01), F2L = 0.11–0.15 (0.14±0.02), F3L = 0.13–0.17 (0.15±0.01), F2W = 0.15–0.20 (0.17±0.01), MsW = 2.44–3.25 (2.85±0.27), SCL = 0.51–0.73 (0.62±0.07), MNL = 0.32–0.44 (0.38±0.04), MPL = 0.38–0.41 (0.39±0.02), MtW = 2.50–3.63 (3.04±0.37).

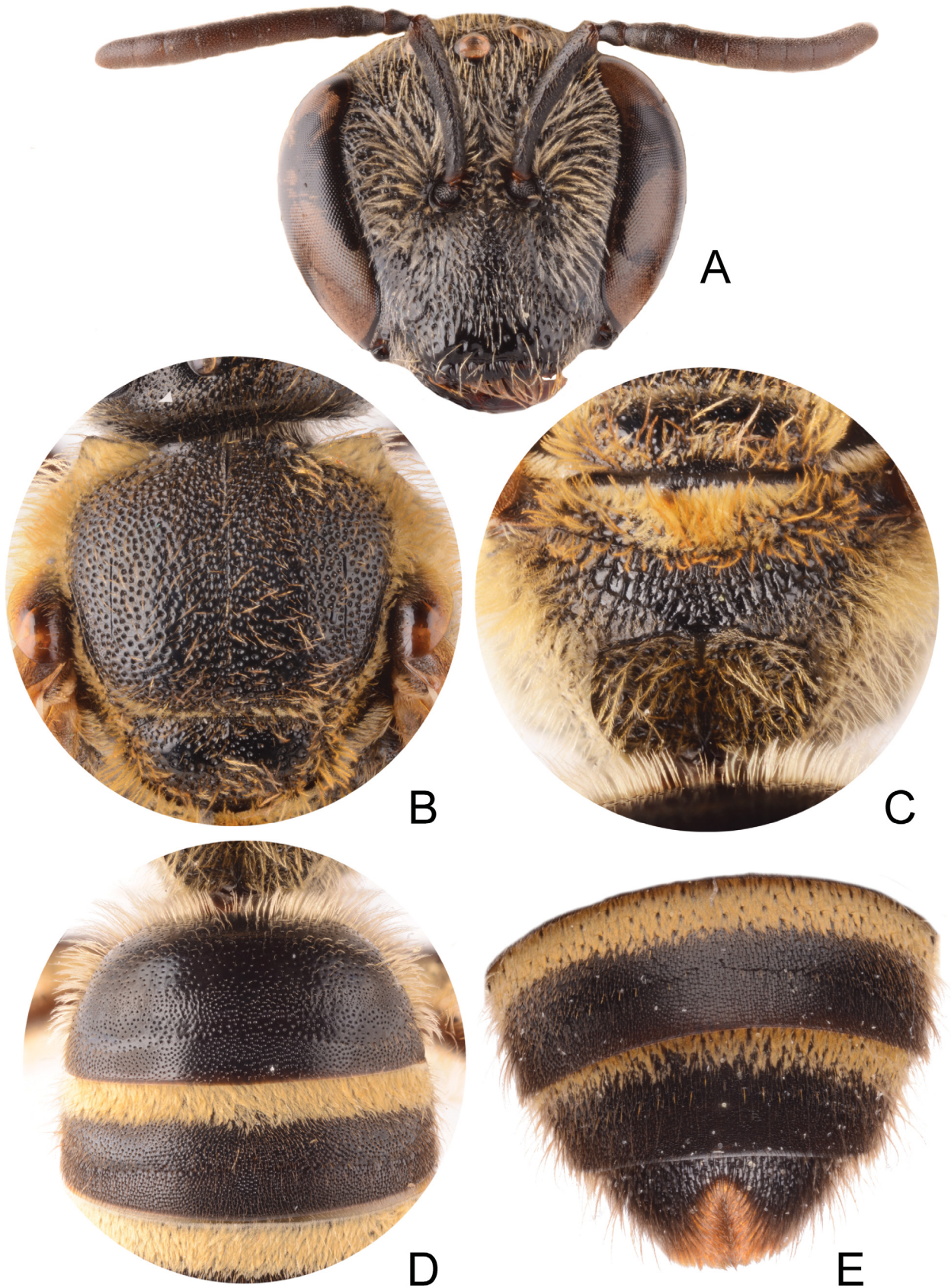
Coloration. Body black except for the following parts: mandible reddish brown apically; tegula yellowish brown translucent; tibial spur yellow; metasomal terga narrowly brown translucent apically. Wings transparent, veins and stigma brown or yellowish brown.

Pubescence. Body hairs whitish and covered with erect and sparse straight or fine branched hairs except for the following parts: pronotum on dorsal area and around lobe, metanotum, propodeum on lateral surface with moderately dense tomentose; hind trochanter, femur, and tibia mixed with plumose hairs, forming scopa. T2–T4 with complete basal hair bands. T4 mixed with blackish brown hairs on apical margin. T5 with mostly blackish brown hairs.

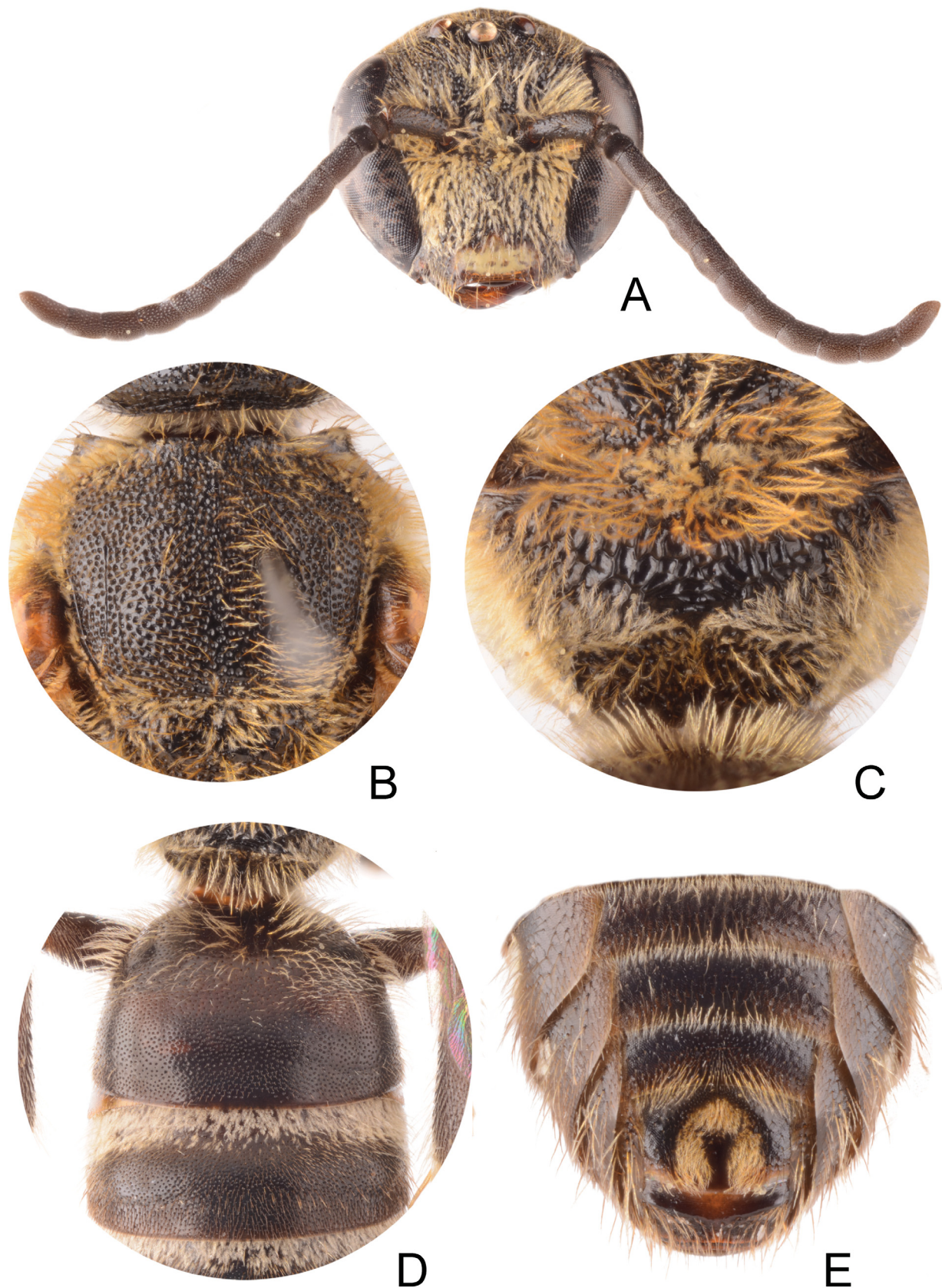
Structure and sculpture. Head nearly as long as wide or wider than long; HW : HL = 1.00 : 0.96. Vertex rounded in frontal view. MOD : UOD : LOD = 1.00 : 0.86 : 0.77. IOD : OOD : OCD = 1.00 : 0.85 : 0.85. IAD : AOD = 1.00 : 0.53. Ocellular area with dense PP, IS smooth (IS = 0.5–1.5 d). Paraocular area and frons with reticulate PP. Supraclypeal area slightly convex, with reticulate PP. CPL : CAL = 1.00 : 0.82. Clypeus nearly flat, with reticulate



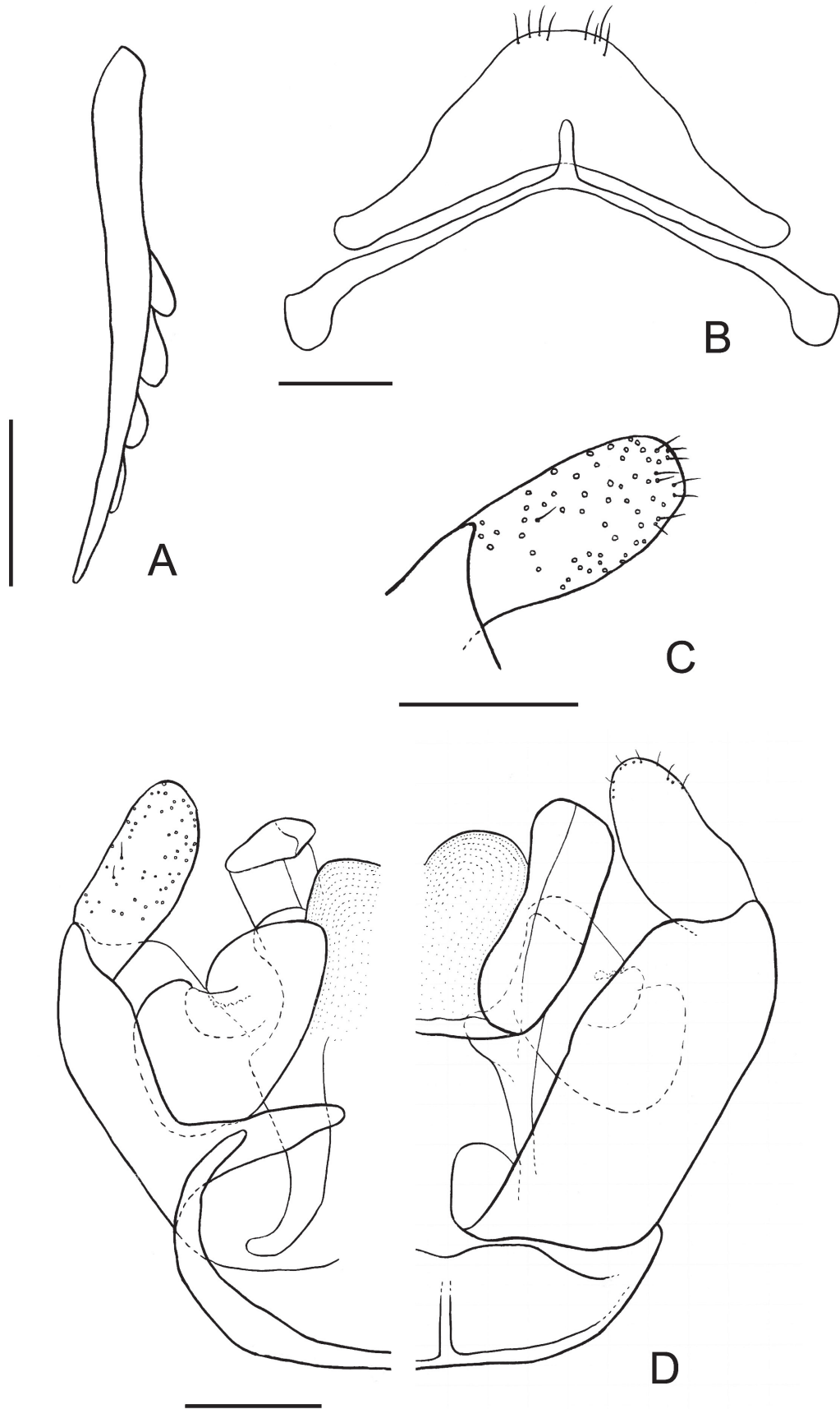
Figs 1 A–F. Dorsal habitus. A–B – *Lasioglossum (Leuchalictus) formosae* (Strand, 1910). C–D – *Lasioglossum (Leuchalictus) subopacum subopacum* (Smith, 1853). E–F – *Lasioglossum (Leuchalictus) subinoum* sp. nov. A, C, E – female. B, D, F – male. E – paratype. F – holotype. Scale bars: 5 mm.



Figs 2A–E. *Lasioglossum (Leuchalictus) formosae* (Strand, 1910), female. A – head in frontal view; B – mesoscutum; C – metapostnotum; D – 1st to 2nd metasomal terga; E – 4th to 6th metasomal terga.



Figs 3A–E. *Lasioglossum (Leuchalictus) formosae* (Strand, 1910), male. A – head in frontal view; B – mesoscutum; C – metapostnotum; D – 1st to 2nd metasomal terga; E – 3rd to 6th metasomal sterna.



Figs 4A–D. *Lasioglossum (Leuchalictus) formosae* (Strand, 1910). A – female; B–D – male. A – inner hind tibial spur; B – 7th to 8th metasomal sterna; C – gonostylus in ventral view; D – genitalia (left, ventral view; right, dorsal view). Scale bars: 0.2 mm.

PP on upper half, and with sparse larger shallow PP on lower half; IS smooth (IS = 2.5–4.0 d on lower part). EW : GW = 1.00 : 0.80. Genal area to postgena with distinct straight ridges. Malar space linear. Occiput not carinate. Hypostomal carinae nearly parallel. Mandible bidentate. Antenna short, not reaching metasoma. F2L : F2W = 1.00 : 0.80; flagellum nearly flattened ventrally.

Dorsolateral angle of pronotum obtuse; lateral surface without ridges; lateral lobe rounded. Tegula ovoid, nearly smooth. Mesoscutum (Fig. 2B) with reticulate PP on anterior 1/3, and with dense PP on remaining part; IS smooth (IS = 0.5–1.5 d medially to posteriorly); parapsidal line narrow groove. Mesoscutellum with reticulate PP marginally, and with sparse PP on submedian area; IS smooth on submedian area (IS = 1–4 d). Metanotum weakly rugulose. Mesepisternum coarsely rugulose over entire surface. SCL : MNL : MPL = 1.00 : 0.61 : 0.63. Propodeum: metapostnotum (Fig. 2C) gently inclined, with reticulate ridges over entire surface; lateral and posterior surfaces rugulose, posterior surface with complete lateral and oblique carinae. Coxae of usual shape, without tubercle. Fore trochanter narrow, longer than wide. Basitibial plate of hind leg carinate marginally. Inner hind tibial spur with blunt serrate 4–6 teeth (n = 5) (Fig. 4A). Fore wing with three submarginal cells.

Submedial patch of T1–T3 slightly convex. Disc of T1 (Fig. 2D) basally with moderately dense PP, and medially to apically with denser PP; IS weakly tessellate over entire surface (IS = 1.0–2.7 d basally, = 0.5–2.0 d medially to apically). Discs of T2–T4 (Figs 2D–E) with dense PP over entire surface; IS weakly tessellate over entire surface (IS = 0.5–1.5 d).

Redescription of male. Measurements (in mm; minimum–maximum (mean ± standard deviation; n = 5). BL = 6.69–9.23 (7.58±0.87), WL = 5.86–6.71 (6.14±0.30), HL = 2.03–2.29 (2.13±0.09), HW = 1.97–2.22 (2.11±0.08), IOD = 0.39–0.46 (0.41±0.03), OOD = 0.35–0.37 (0.36±0.01), OCD = 0.33–0.39 (0.37±0.02), UOD = 1.28–1.39 (1.33±0.04), MOD = 1.35–1.50 (1.44±0.05), LOD = 1.00–1.11 (1.04±0.04), IAD = 0.24–0.33 (0.27±0.03), AOD = 0.28–0.33 (0.30±0.01), CAL = 0.37–0.43 (0.40±0.03), CPL = 0.52–0.54 (0.53±0.01), EL = 1.49–1.59 (1.53±0.04), EW = 0.60–0.70 (0.65±0.03), GW = 0.41–0.51 (0.46±0.03), SPL = 0.46–0.59 (0.52±0.04), F1L = 0.13–0.15 (0.14±0.01), F2L = 0.28–0.35 (0.31±0.02), F3L = 0.28–0.30 (0.30±0.01), F2W = 0.17–0.22 (0.20±0.02), MsW = 2.50–2.81 (2.60±0.13), SCL = 0.51–0.60 (0.55±0.04), MNL = 0.29–0.38 (0.34±0.04), MPL = 0.35–0.41 (0.39±0.02), MtW = 2.13–2.38 (2.24±0.08).

Coloration. Body black except for the following parts: mandible reddish brown apically; clypeus with yellow spot on lower half (Fig. 3A); tegula yellowish brown translucent; tibial spur yellow; metasomal terga narrowly yellowish brown translucent apically. Wings transparent, veins and stigma pale brown.

Pubescence. Body hairs whitish and covered with erect and sparse straight or fine branched hairs except for the following parts: lower paraocular and supraclypeal area, pronotal dorsum and around lobe, metanotum, lateral surface of propodeum with dense tomentose. T2–T3 or T2–T4

with complete basal hair bands. Hair tuft on S6 Ω shaped.

Structure and sculpture. Head nearly as long as wide; HW : HL = 1.00 : 1.01. Vertex rounded in frontal view. MOD : UOD : LOD = 1.00 : 0.92 : 0.72. IOD : OOD : OCD = 1.00 : 0.86 : 0.88. IAD : AOD = 1.00 : 0.90. Ocellular area with dense PP; IS smooth (IS = 0.5–1.5 d). Paraocular area and frons with reticulate PP. Supraclypeal area slightly convex, with reticulate PP. CPL : CAL = 1.00 : 0.74. Clypeus nearly flat, with larger shallow PP over entire surface, moderately dense; IS nearly smooth (IS = 0.5–1.5 d). EW : GW = 1.00 : 0.72. Genal area and postgena with weak straight ridges. Malar space linear. Hypostomal carinae nearly parallel. Mandible edentate. Antenna short, not reaching metasoma (Fig. 1B). F2L : F2W = 1.00 : 1.54; F3–F10 slightly convex ventrally.

Dorsolateral angle of pronotum obtuse; lateral surface without ridges; lateral lobe rounded. Tegula ovoid, nearly smooth. Mesoscutum (Fig. 3B) with reticulate PP on anterior 1/3, and with dense PP on remaining area; IS smooth (IS = 0.5–1 d); parapsidal line narrow groove. Mesoscutellum with reticulate PP except for submedian area that is with dense PP; IS smooth on submedian area (IS = 0.5–1.5 d). Metanotum and mesepisternum coarsely rugulose over entire surface. SCL : MNL : MPL = 1.00 : 0.63 : 0.71. Propodeum: metapostnotum (Fig. 3C) gently inclined, with irregular sinuate ridges over entire surface; lateral and posterior surfaces coarsely rugulose, the latter with complete lateral and oblique carinae. Coxae of usual shape, without tubercle. Fore trochanter narrow, longer than wide. Basitibial plate of hind leg carinate marginally. Inner hind tibial spur finely serrate. Fore wing with three submarginal cells.

Discs of T1–T4 (Fig. 3D for T1–T2) with dense PP over entire surface; IS weakly tessellate over entire surface (IS = 0.5–1.5 d). Submedial patch of T1–T4 slightly convex. T7 without distinct lateral projection. S7–S8 (Fig. 4B): S7 with short and narrow median process; S8 without median process.

Genitalia (Figs 4C–D). Gonobase flat at bottom, ventral arms not connected with each other at upper ends; gonocoxite smooth; gonostylus bud-like, with sparse short hairs.

Flight records in Taiwan. Female: March to November. Male: April to November.

Distribution. China (PESENKO 2006), Korean Peninsula (EBMER 1978, MURAO et al 2015a), Nepal (cited from PESENKO 2006), Taiwan (STRAND 1910, COCKERELL 1911, EBMER & MAETA 1999), Vietnam (PESENKO 2006).

Lasioglossum (*Leuchalictus*) *subopacum subopacum*
(Smith, 1853)

(Figs 1C–D, 6–9)

Halictus subopacus Smith, 1853: 63. Syntypes: ♀ (coll. Natural History Museum, London, United Kingdom): Foo–cho–foo (now Fuzhou, Fujian Prov.), China].

Halictus subopacus: SMITH (1873): 200 [in list]; DALLA TORRE (1896): 85. *Lasioglossum* (*Sericohalictus*) *subopacum*: PESENKO (1986): 137 [in key]. *Lasioglossum* (*Lasioglossum*) *subopacum*: EBMER (1980): 500–501; SAKAGAMI & TADAUCHI (1995): 183, fig. 16; EBMER (1998): 410; EBMER & MAETA (1999): 230, figs 7–9; MURAO (2011): 84–86, 88 [illustration], 91 [photograph].

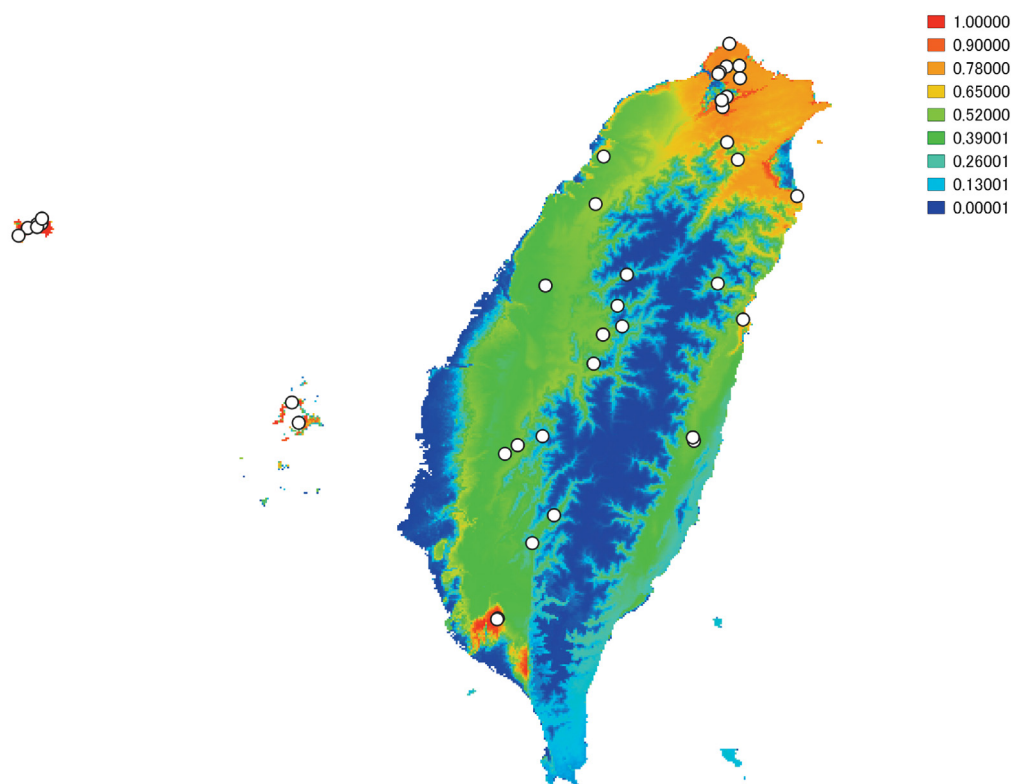


Fig. 5. Distribution map of *Lasioglossum (Leuchalictus) formosae* (Strand, 1910). Heat map indicates suitable range predicted by Maxent's analysis. White circles indicate geo-referenced specimen records.

Lasioglossum (Leuchalictus) subopacum: PESENKO (2006): 141, 143 [illustrations], 159; MURAO et al. (2015a): 517 [photograph], 526 [photograph], 528–529, 530–531 [in key].

Halictus chiniae Strand, 1910: 182. Syntypes: ♀ (coll. Museum für Naturkunde, Berlin, Germany): Tsingtau (now Qingdao, Shandong Prov., China). Synonymy by BLÜTHGEN (1926a: 500; 1926b: 396).

Halictus chiniae: STRAND (1915): 63 [in list].

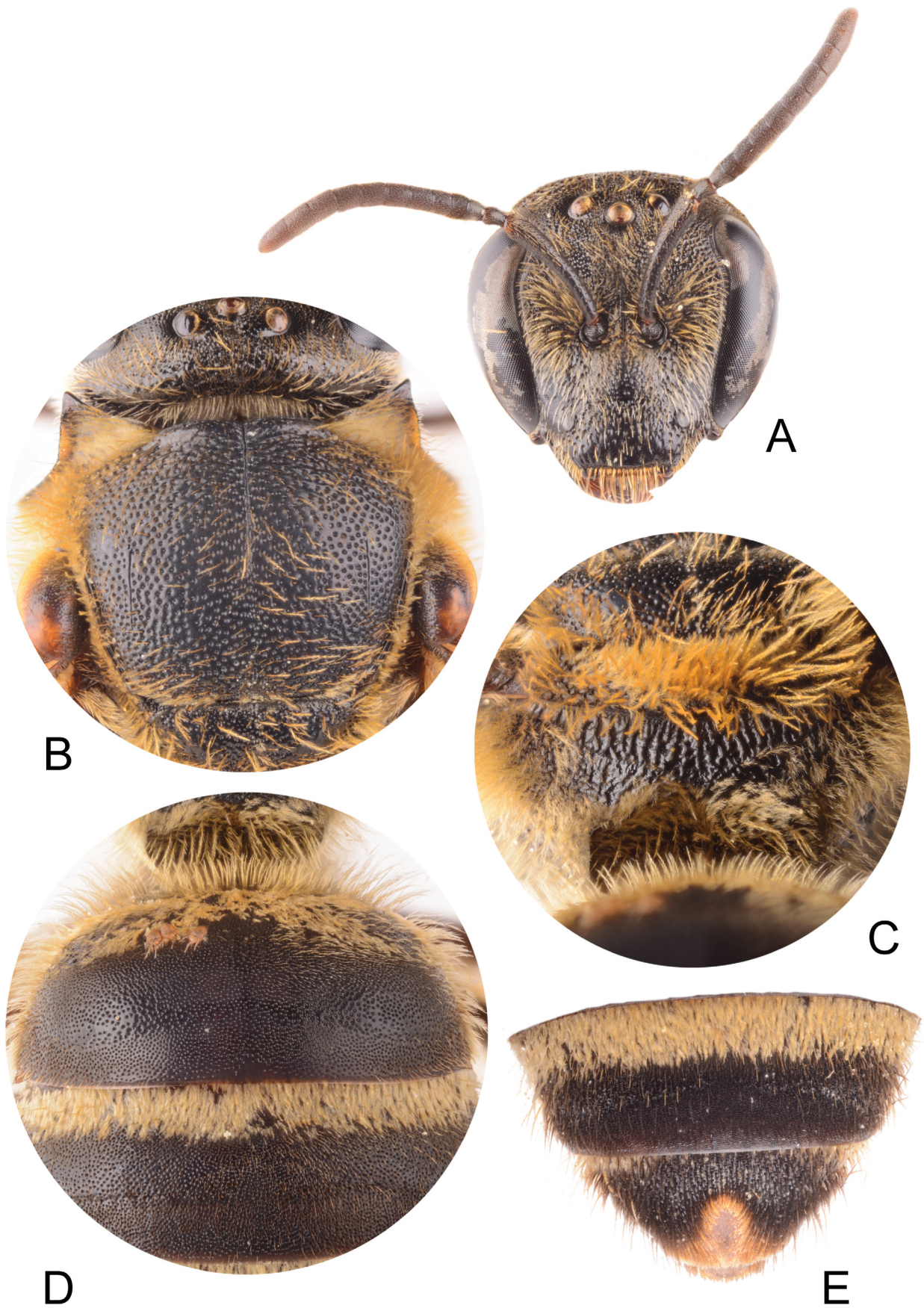
Halictus horishensis Cockerell, 1911: 662. Holotype: ♂ (coll. U. S. National Museum of Natural History, Smithsonian Institution, Washington, DC, USA): Horisha, Taiwan. Synonymy by EBMER (1980: 501).

Halictus perangulatus Cockerell, 1911: 663 [in key], 666. Syntypes: 7 ♀♀ (coll. Museum für Naturkunde, Berlin, Germany): Taiwan. Synonymy by BLÜTHGEN (1922: 63).

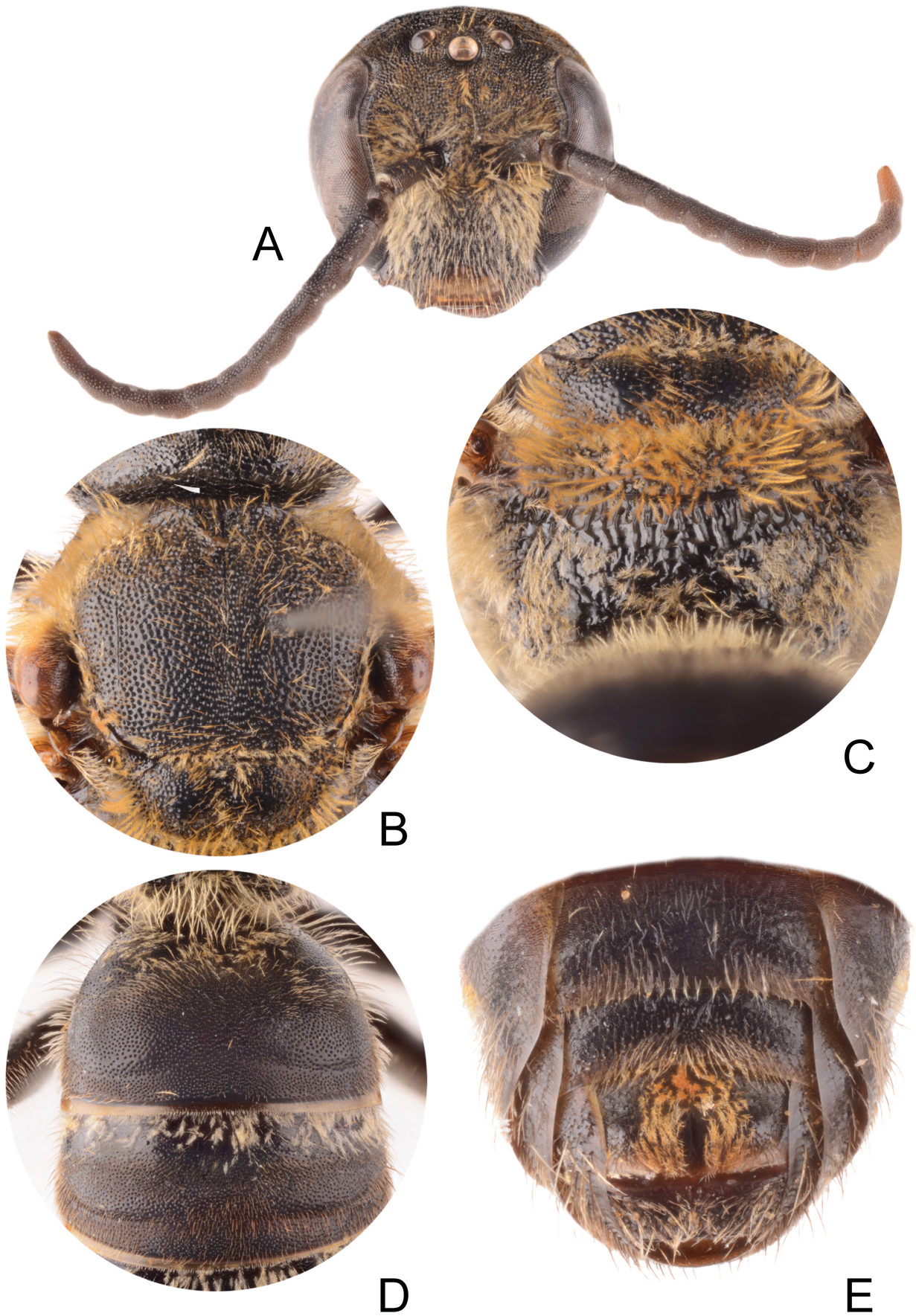
Halictus baguionis Crawford, 1918: 170. Holotype: ♀ (coll. U. S. National Museum of Natural History, Smithsonian Institution, Washington, DC, USA): Luzon, Bagua, Philippines. Synonymy by BLÜTHGEN (1926b: 416).

Material examined. TAIWAN: TAIPEI CITY: 1 ♂, Qixingshan, 2.ix.2014, S. S. Lu (TFRI, 00196076); 2 ♂♂, Zhogzhengshan, Beitou, 24.xi.2016, S. S. Lu & W. C. Yeh (TFRI, 00196415, 00196416); 1 ♂, Zhuzihu, 22.vii.2011, S. S. Lu (TFRI, 00165928). **NEW TAIPEI CITY:** 1 ♀, Baishawan, 18.x.2002, W. C. Yeh (TFRI, 00093526); 1 ♀, Ergshan, Shiding, 12.x.2010, S. S. Lu (TFRI, 00130557); 1 ♀, Guanyingshan, 15.x.2017, S. S. Lu & W. C. Yeh (TFRI, 00197932); 1 ♀, Hengshan, Sanzhi, 18.x.2002, S. S. Lu (TFRI, 00093498); 1 ♂, Homeishan, Xindian, 12.vii.2017, W. C. Yeh (TFRI, 00197506); ditto, 17.ix.2017, W. C. Yeh (TFRI, 00197056, 00197060); 1 ♂, ditto, 20.x.2017, W. C. Yeh (TFRI); 1 ♀, ditto, 27.vi.2017, W. C. Yeh (TFRI, 00202699); 1 ♂, ditto, 28.vi.2017, W. C. Yeh (TFRI, 00197464); 1 ♀, ditto, 5.x.2018, W. C. Yeh (TFRI, 00203740); 1 ♀, Laomei, 5.xi.2002, W. C. Yeh (TFRI, 00094407); 1 ♀, Menhu, Xizhi, 14.ix.2002, W. C. Yeh (TFRI, 00093665); 1 ♀, Neidong logging trail, Wulai, 24.ix.2017, W. C. Yeh (TFRI, 00203404); 1 ♀, ditto, 28.iii.2017, W. C. Yeh (TFRI, 00196901); 1 ♀, Shimen, 5.xi.2002, W. C. Yeh (TFRI, 00094443); 1 ♀ 1 ♂, Kueishanlu, 6.vii.1966, T. Tano (ELKU); 3 ♀♀, Wulai, alt. 385 m, 24.8408444, 121.5340889, 31.iii.2018, R. Murao (cMur); 1 ♀ 1 ♂, Xiaogetou, 16.x.2017, W. C. Yeh (TFRI, 00197956,

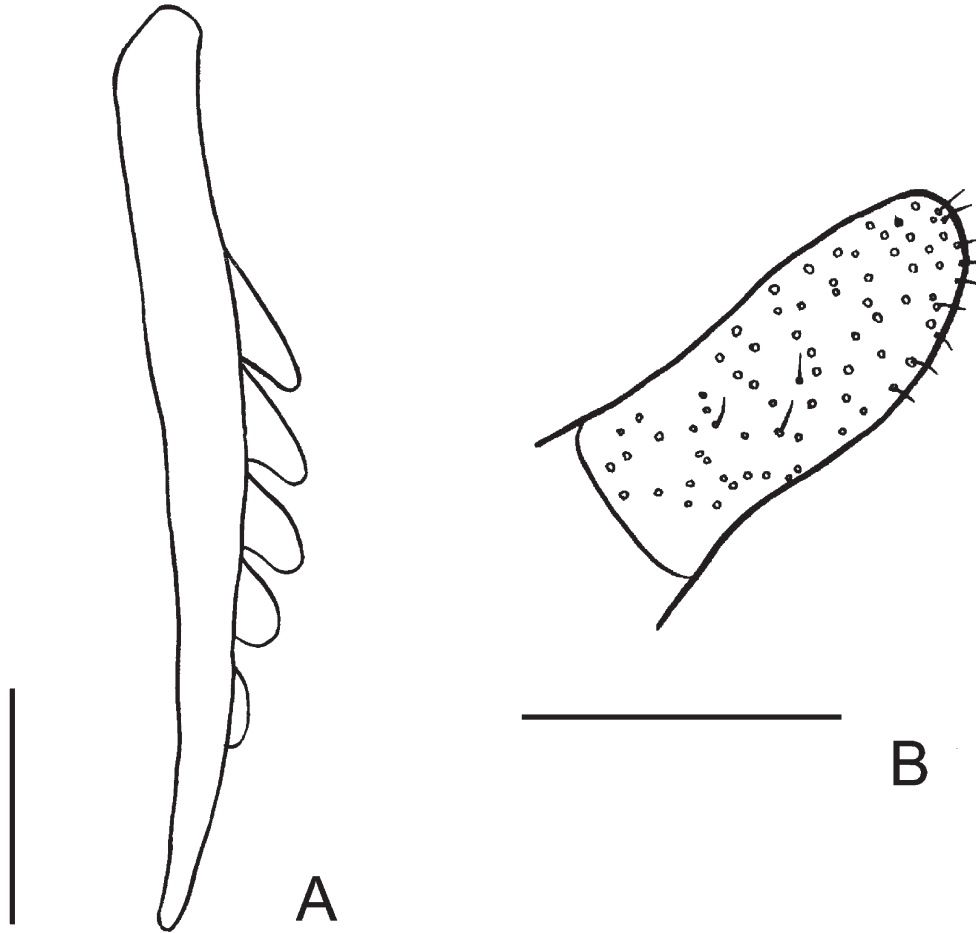
00197961); 2 ♀♀, Xinxian, 3.vii.2017, W. C. Yeh (TFRI, 00197406, 00197407). **TAOYUAN CITY:** 1 ♀, Baijii, Daxi, 27.x.2017, W. C. Yeh (TFRI, 00202698); 1 ♀, Cihu, 28.iv.2003, S. S. Lu (TFRI, 00101044); 2 ♂♂, Yangmei, 5.vii.1966, T. Tano (ELKU). **HSINCHU CITY:** 1 ♀ 1 ♂, NTHU, 14.vi.2014, S. S. Lu (TFRI, 00181114, 00181115); 1 ♀, Shinchiku, 1.vii.1930, J. Sonan & K. Miyake (ELKU). **NANTOU COUNTY:** 1 ♀, Heshu, 9.ix.2017, S. S. Lu (TFRI, 00197486); 1 ♀ 1 ♂, Huisun EFS, 28.x.2011, S. S. Lu (TFRI, 00104805, 00104796); 1 ♀ 1 ♂, Jijiidashan, 20.ix.2017, S. S. Lu & W. C. Yeh (TFRI, 00197516, 00197517); 1 ♀, Kwantaushih, 13.viii.1972, S. Yamane (ELKU); 1 ♀, ditto, 14.viii.1972, S. Yamane (ELKU); 2 ♀♀, ditto, 18.iv.1973, Sk. Yamane (ELKU); 1 ♂, ditto, 21.v.1973, S. Yamane (ELKU); 4 ♂♂, ditto, 22.v.1973, S. Yamane (ELKU); 1 ♀, ditto, 3–4.vii.1973, S. Yamane (ELKU); 1 ♀, Lienhuachi, 30.vi.2015, S. S. Lu (TFRI, 00197772); 2 ♀♀, Nans(h)anchi, 24.iv.1974, M. Shiokawa (ELKU); 1 ♂, ditto, 21.vi.1965, T. Shirouzu (ELKU); 1 ♀, ditto, 11.v.1980, Sk. Yamane (ELKU); 3 ♀♀, Nantou, alt. 295 m, 23.99895, 120.7855833, 29.iii.2018, R. Murao (cMur); 1 ♂, Chienching, 9.vii.1966, T. Tano (ELKU); 1 ♀, Penpuchi, 27.iv.1965, T. Shirouzu (ELKU); 1 ♀ 1 ♂, ditto, 10.vii.1966, T. Tano (ELKU); 1 ♂, ditto, 16.vii.1966, T. Tano (ELKU); 2 ♀♀, Puli, 16.v.1973, Sk. Yamane (ELKU); 1 ♂, ditto, 25.x.1976, Sk. Yamane (ELKU); 1 ♀ 1 ♂, ditto, 25–28.x.1972, Sk. Yamane (ELKU); 3 ♀♀ 3 ♂♂, Sun Moon Lake, 3.vii.1986, K. Baba (ELKU); 1 ♀, ditto, 4.vii.1986, K. Baba (ELKU); 2 ♀♀, Wushe, 29.x.–2.xi.1972, Sk. Yamane (ELKU); 1 ♀, ditto, 24.iv.1974, M. Shiokawa (ELKU); 2 ♀♀, ditto, 25.iv.1974, M. Shiokawa (ELKU). **YUNLIN COUNTY:** 1 ♂, Huashan, 14.iv.2018, I. H. Sung (TFRI, 00202498). **CHIAYI COUNTY:** 1 ♂, Shihtzulu, 29.vii.1966, T. Tano (ELKU); 1 ♀, Leye, Alishan, 9.iv.2015, S. S. Lu (TFRI, 00182509); 1 ♀, Naoliao, Fanlu, 26.iii.2014, S. S. Lu & W. C. Yeh (TFRI, 00197080). **KAOSHIUNG CITY:** 1 ♂, Tien Chi, alt. 2,100–2,200 m, 3–4.x.1986, K. Baba (ELKU). **PINGTUNG COUNTY:** 1 ♂, Dewen, 25.iv.2013, S. S. Lu & W. C. Yeh (TFRI, 00180527); 1 ♀, Gangkou, Manzhou, 24.iv.2013, S. S. Lu (TFRI, 00180549); ditto, 14.x.2015, S. S. Lu (TFRI, 00203405); 1 ♀, Hengchun Research Center, 14.x.2015, S. S. Lu (TFRI, 00198471); 1 ♀, Kending, 20.x.2017, W. C. Yeh (TFRI, 00198024); 1 ♂, ditto, 22.x.2017, W. C. Yeh (TFRI); 1 ♀, Machia, 25.x.2013, S. S. Lu & W. C. Yeh (TFRI,



Figs 6A–E. *Lasioglossum (Leuchalictus) subopacum subopacum* (Smith, 1853), female. A – head in frontal view; B – mesoscutum; C – metapostnotum; D – 1st to 2nd metasomal terga; E – 5th to 6th metasomal terga.



Figs 7A–E. *Lasioglossum (Leuchalictus) subopacum subopacum* (Smith, 1853), male. A – head in frontal view; B – mesoscutum; C – metapostnotum; D – 1st to 2nd metasomal terga; E – 4th to 6th metasomal sterna.



Figs 8A–B. *Lasioglossum* (*Leuchalictus*) *subopacum subopacum* (Smith, 1853). A – female; B – male. A – inner hind tibial spur; B – gonostylus in ventral view. Scale bars: 0.2 mm.

00196192). **YILAN COUNTY:** 3 ♂♂, Fushan BG., 7.vi.2012, S. S. Lu (TFRI, 00202499, 00202500, 00202695); 2 ♂♂, ditto, 2.v.1980, Sk. Yamane (ELKU). **HUALIEN COUNTY:** 1 ♂, Juisui, 1.v.1980, Sk. Yamane (ELKU); 1 ♀, Liyuchi, 20.iv.1994, S. Y. G. (TFRI, 00072400). **TAITUNG COUNTY:** 2 ♀♀, Lanyu Island, 11.v.2017, S. S. Lu (TFRI, 00203406, 00203407). **UNCERTAIN:** 1 ♀, Kanshirei, 20.x.1920, Sonan (ELKU).

Diagnosis. This species is similar to *Lasioglossum sakishima* Ebmer & Maeta, 1999 from Japan (Ryukyu Islands). According to MURAO et al. (2015a), *L. subopacum* is separated from *L. sakishima* by female mesoscutum with dense transverse ridges on its medio-anterior region (MURAO et al. 2015a: fig. 2A) and female mesoscutum and mesoscutellum mixed with dark hairs. In contrast, in *L. sakishima*, female mesoscutum is reticulated among punctures on its medio-anterior region and female mesoscutum and mesoscutellum have only yellowish brown hairs.

In addition, this species is divided into two subspecies (MURAO 2011), the nominotypical subspecies ranging from the Korean Peninsula to Southeastern Asia, and *L. subopacum okinawa* Ebmer & Maeta, 1999 from Japan (Ryukyu Islands). The nominotypical subspecies is separated from *L. s. okinawa* by female propodeum and T1 basally with thick, yellowish tomentose hairs (MURAO 2011: figs 20,

22). In contrast, in *L. s. okinawa*, female propodeum and T1 basally bear thinner whitish tomentose hairs (MURAO 2011: figs 21, 23).

Flight records in Taiwan. Female: March to November. Male: April to November.

Distribution. China (SMITH 1853, STRAND 1910, PESENKO 2006, MURAO 2011), Korean Peninsula (MURAO 2011, MURAO et al. 2015a), Philippines (CRAWFORD 1918), Taiwan (COCKERELL 1911, EBMER & MAETA 1999), Vietnam (PESENKO 2006).

***Lasioglossum* (*Leuchalictus*) *subinoum* sp. nov.**
(Figs 1E–F, 10–13)

Lasioglossum inoum (misidentification): MURAO (2015: 2).

Type material. HOLOTYPE: ♂, Guanwu, Hsinchu Co., Taiwan, 3.vii.2014, S. S. Lu (TFRI, 00181144). PARATYPES: **TAIWAN: Hsinchu County:** 4 ♀♀, Guanwu, Hsinchu Co., 11.vii.2012, S. S. Lu (TFRI, 00179448–00179451); 3 ♀♀, ditto, 24.v.2012, I. H. Sung (TFRI, 1 ♀ 00202697); 2 ♀♀ 1 ♂, ditto, 3.vii.2014, S. S. Lu (TFRI, 2 ♀♀ 00181140, 00181141). **TAICHUNG CITY:** 1 ♀, Wuling, 17.viii.2017, W. C. Yeh (TFRI, 00202696). **NANTOU COUNTY:** 1 ♂, Sungkan, 2,000 m–Tsifen, 2,300 m, S. 27.vi.1965, Kimoto (ELKU); 1 ♂, ditto, 29.vi.1965, S. Kimoto (ELKU). **CHIAYI COUNTY:** 1 ♀, Alishan, 2,300 m, 9.iv.1965, Y. Hirashima (ELKU); 1 ♀ 1 ♂, Fenchifu, 1,405 m, 1.ix.1979, Y. Hirashima (ELKU); 1 ♀, ditto, 31.viii.1979, Y. Hirashima (ELKU). **KAOHSIUNG CITY:** 1 ♀, Yakou, alt.

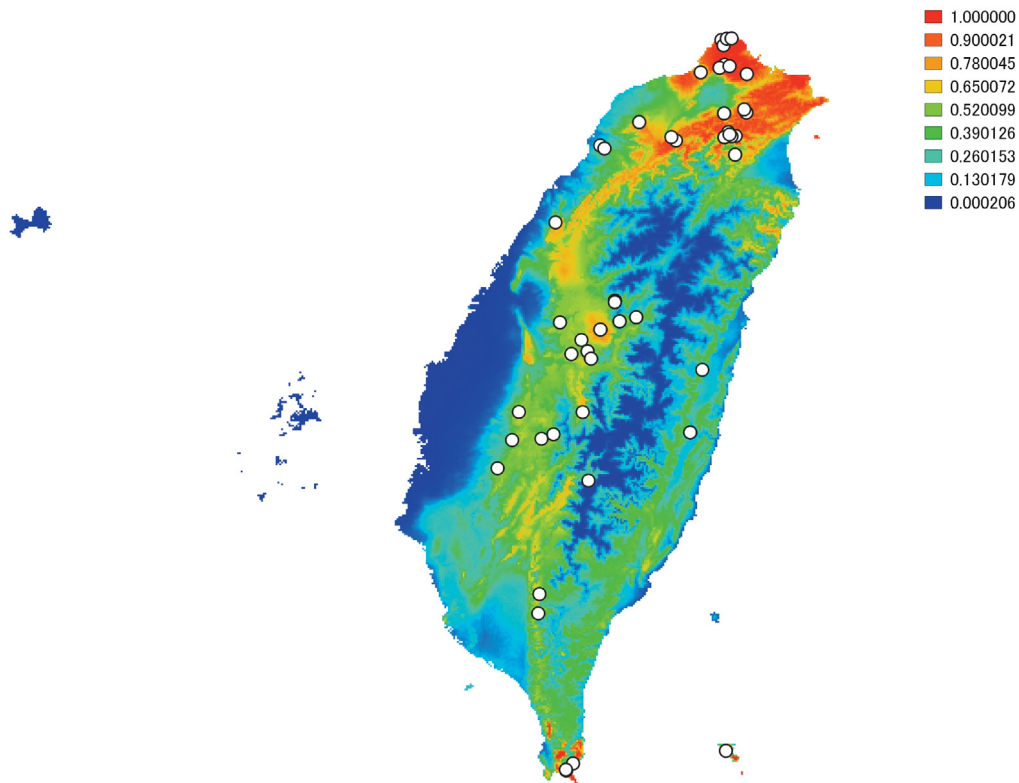


Fig. 9. Distribution map of *Lasioglossum (Leuchalictus) subopacum subopacum* (Smith, 1853). Heat map indicates suitable range by predicted Maxent's analysis. White circles indicate geo-referenced specimen records.

2,800 m, 1.viii.1986, K. Baba (ELKU). **TAITUNG COUNTY:** 1 ♀ 2 ♂♂, Liuan, alt. 1,800 m, K. Baba (ELKU). **YILAN COUNTY:** 1 ♀, Taiheizan, 30.iii.1935, J. Sonan (ELKU); 2 ♀♀ 1 ♂, Taiheizan (Taihoku-shu) Taiheizan-Kamiyodani, 25.vii.1932, T. Esaki (ELKU). **UNCERTAIN:** 1 ♀, Faunchiikwa, 22.x.1977, K. Yamauchi (ELKU); 1 ♀, Fenuchiiknsa, 22.x.1977, K. Yamauchi (ELKU); 1 ♀, Kanzan (Kanzan-goe), 16.viii.1932, K. Nomura (ELKU).

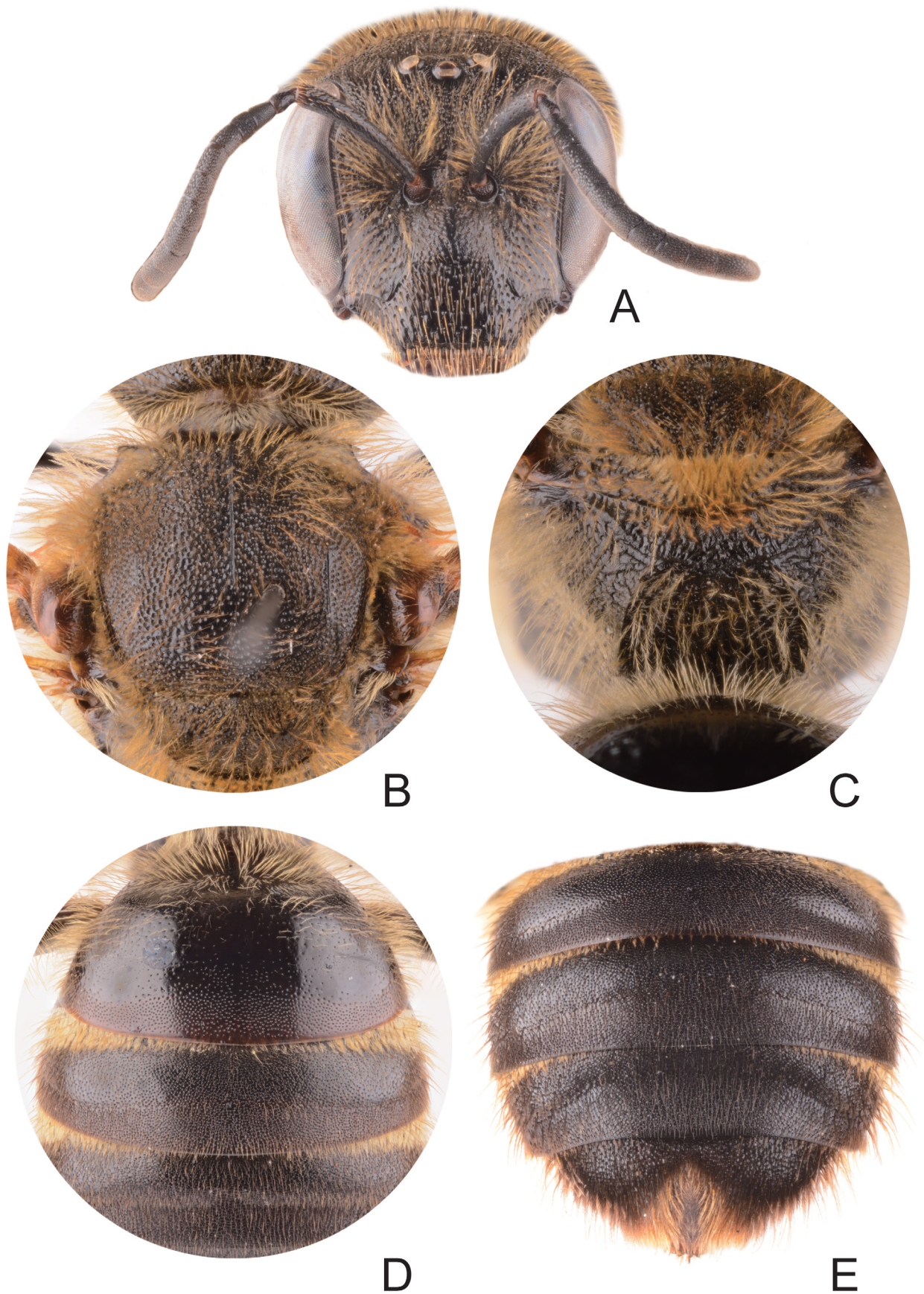
Diagnosis. This species is similar to *Lasioglossum inoum* from south to southeastern Asia. It is separated from *L. inoum* by female T4 distinctly depressed (Fig. 10E) and the hair tuft on male S6 not tapering toward the tip (Fig. 11F). In contrast, in *L. inoum*, female T4 is nearly flat and the hair tuft on male S6 tapers towards the tip.

Description of female. Measurements (in mm; minimum–maximum (mean ± standard deviation; n = 5). BL = 9.54–10.69 (10.08±0.40), WL = 8.43–8.86 (8.63±0.17), HL = 2.67–2.76 (2.74±0.04), HW = 2.67–2.79 (2.74±0.05), IOD = 0.41–0.46 (0.43±0.01), OOD = 0.54–0.57 (0.55±0.01), OCD = 0.46–0.54 (0.47±0.02), UOD = 1.72–1.78 (1.75±0.02), MOD = 1.80–1.91 (1.87±0.04), LOD = 1.74–1.80 (1.77±0.03), IAD = 0.28–0.33 (0.30±0.02), AOD = 0.52–0.59 (0.55±0.03), CAL = 0.50–0.57 (0.53±0.03), CPL = 0.61–0.65 (0.63±0.02), EL = 1.62–1.78 (1.70±0.06), EW = 0.63–0.67 (0.65±0.02), GW = 0.76–0.89 (0.82±0.05), SPL = 1.20–1.30 (1.23±0.04), F1L = 0.20 (0.20±0.00), F2L = 0.15–0.20 (0.17±0.01), F3L = 0.17–0.20 (0.19±0.01), F2W = 0.20 (0.20±0.00), MsW = 3.19–3.38 (3.26±0.06), SCL = 0.67–0.83 (0.74±0.05), MNL = 0.38–0.48 (0.44±0.03), MPL = 0.35–0.44 (0.39±0.03), MtW = 3.56–3.88 (3.71±0.01).

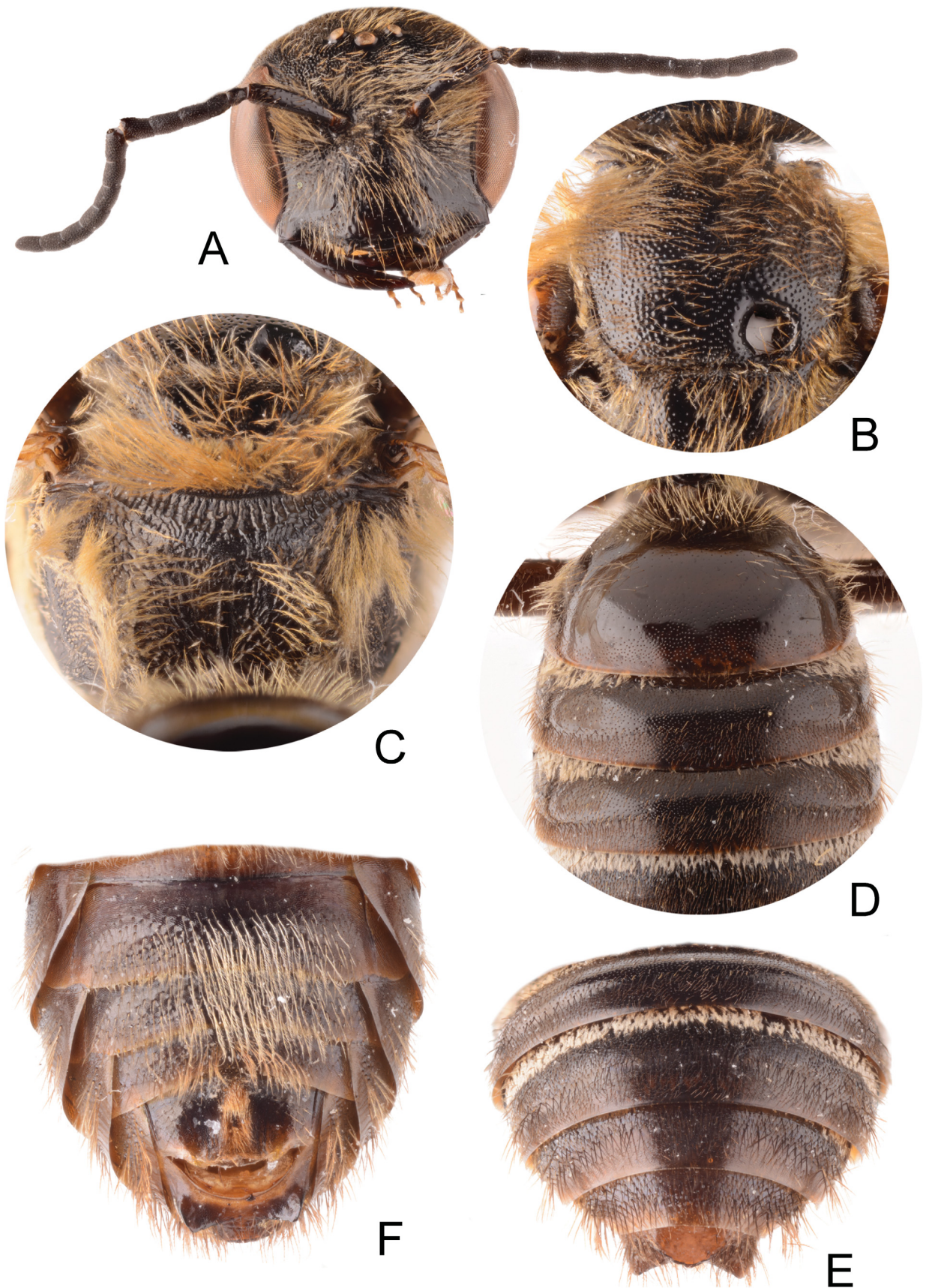
Coloration. Body black except for the following parts: mandible reddish brown apically; tegula yellowish brown translucent; tibial spur yellow; T1–T2 narrowly yellowish brown translucent apically. Wings slightly brownish; veins and stigma brown.

Pubescence. Body covered with erect and sparse straight or fine branched hairs except for the following parts: pronotum on dorsal area and around lobe, metanotum with moderately dense tomentose; hind trochanter, femur, and tibia mixed with plumose hairs, forming scopa; T1 basolaterally with thin appressed hairs (Fig. 10D). Basal hair bands of metasomal terga present on T2–T4 complete or incomplete. Head and mesosoma mostly whitish, but weakly pale fulvous on mesoscutum to metanotum, and mixed with blackish brown hairs on lower margin of clypeus and outer surface of all tibiae and basitarsi. T1 with whitish hairs, not mixed with blackish hairs. T2 with whitish hairs as well as T1 but mixed with blackish hairs on disc. T3–T5 mostly with blackish hairs. Metasomal sterna with weak pale fulvous hairs.

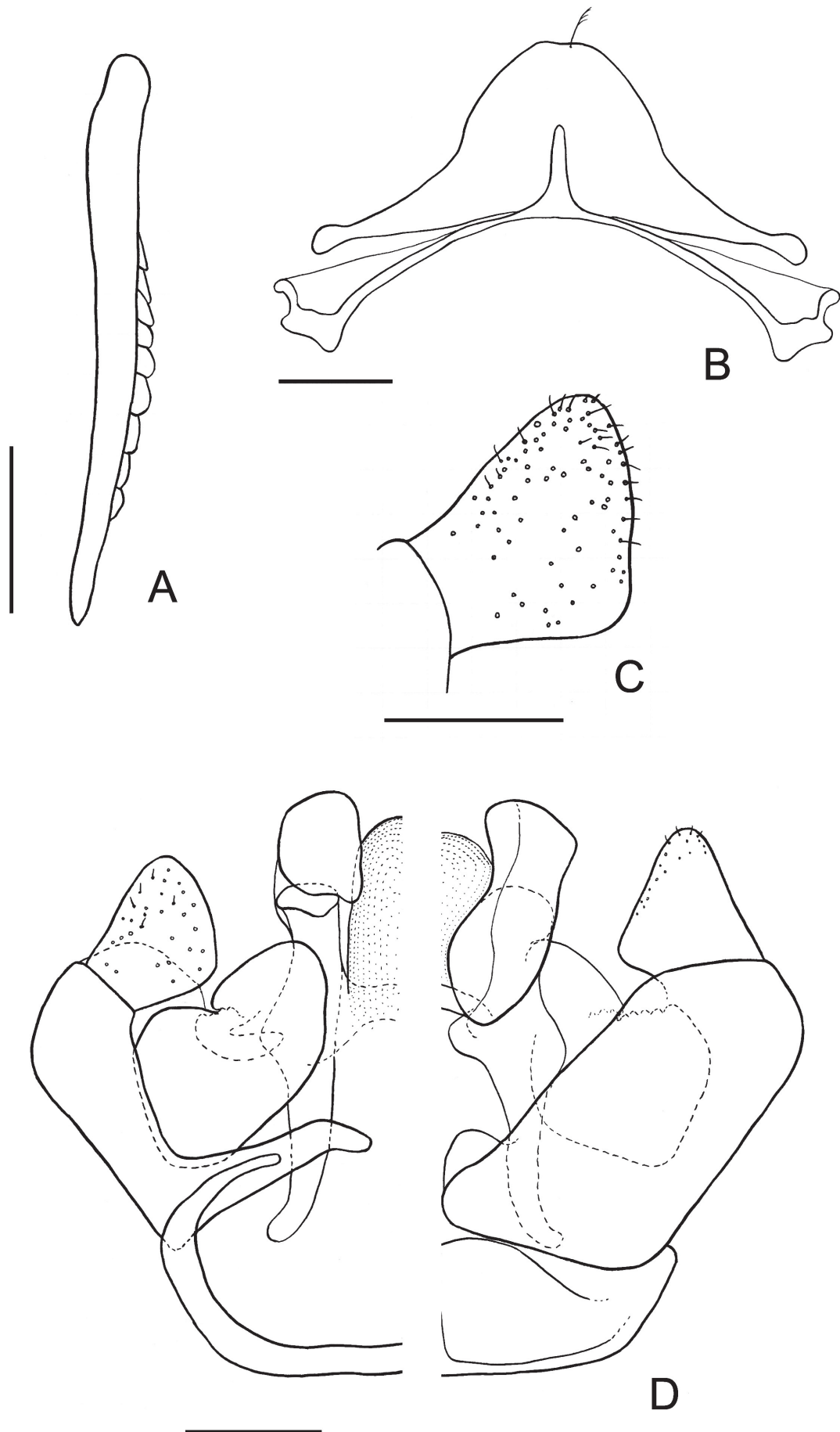
Structure and sculpture. Head nearly as long as wide; HW : HL = 1.00 : 1.00. Vertex nearly flat on top in frontal view. MOD : UOD : LOD = 1.00 : 0.94 : 0.95. IOD : OOD : OCD = 1.00 : 1.26 : 1.09. IAD : AOD = 1.00 : 0.54. Ocellular area with moderately dense PP, IS smooth (IS = 0.5–2.0 d). Frons with reticulate PP. Paraocular area with shallow reticulate PP. Supraclypeal area slightly convex, with dense PP, IS weakly tessellate (IS = 1–2 d). CPL : CAL = 1.00 : 0.83. Clypeus nearly flat, with moderately dense



Figs 10A–E. *Lasioglossum (Leuchalictus) subinoum* sp. nov., paratype, female. A – head in frontal view; B – mesoscutum; C – metapostnotum; D – 1st to 2nd metasomal terga; E – 3rd to 6th metasomal terga.



Figs 11A–F. *Lasioglossum (Leuchalictus) subinoum* sp. nov., holotype, male. A – head in frontal view; B – mesoscutum; C – metapostnotum; D – 1st to 3rd metasomal terga; E – 3rd to 7th metasomal terga; F – 3rd to 6th metasomal sterna.



Figs 12A–D. *Lasioglossum* (*Leuchalictus*) *subinoum* sp. nov. A – paratype, female; B–D – paratype, male. A – inner hind tibial spur; B – 7th to 8th metasomal sterna; C – gonostylus in ventral view; D – genitalia (left, ventral view; right, dorsal view). Scale bars: 0.2 mm.

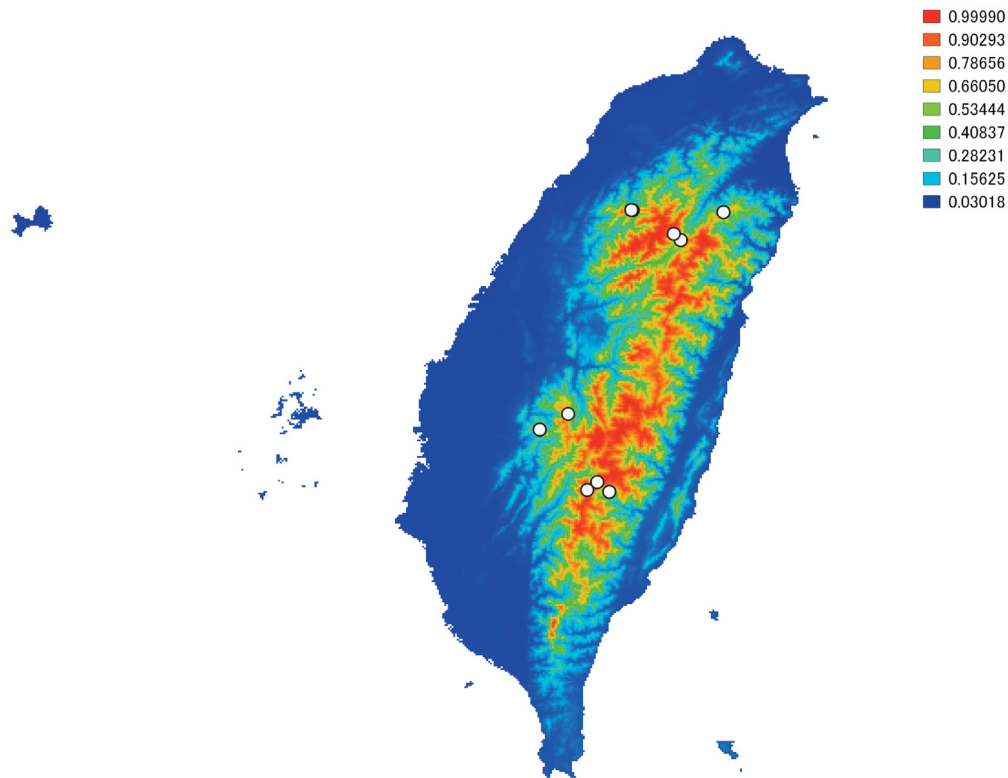


Fig. 13. Distribution map of *Lasioglossum (Leuchalictus) subinoum* sp. nov. Heat map indicates suitable range predicted by Maxent's analysis. White circles indicate geo-referenced specimen records.

larger shallow PP over entire surface; IS nearly smooth (IS = 1–3 d). EW : GW = 1.00 : 1.26. Genal area to postgena with distinct straight ridges. Malar space linear. Occiput not carinate. Hypostomal carinae nearly parallel. Mandible bidentate. Antenna short, not reaching metasoma. F2L : F2W = 1.00 : 0.89; flagellum nearly flattened ventrally.

Dorsolateral angle of pronotum obtuse; lateral surface with distinct ridge; lateral lobe rounded. Tegula ovoid, nearly smooth. Mesoscutum (Fig. 10B) with reticulate PP on anterior and lateral margin, and with dense PP on remaining area; IS smooth (IS = 0.5–1.5 d medially to posteriorly); parapsidal line narrow groove. Mesoscutellum with reticulate PP except for submedian area that is densely punctate; IS smooth on submedian area (IS = 0.5–1.0 d on submedian area). Metanotum rugulose. Mesepisternum coarsely rugulose over entire surface. SCL : MNL : MPL = 1.00 : 0.59 : 0.53. Propodeum: metapostnotum (Fig. 10C) gently inclined, with longitudinal ridges reaching posterior margin, with weak tessellation among ridges; junction between metapostnotum and posterior surface not carinate; lateral and posterior surface rugulose; posterior surface with complete lateral carina, and without oblique carina. Coxae usually shaped, without tubercle. Fore trochanter narrow, longer than wide. Basitibial plate of hind leg carinate marginally. Inner hind tibial spur with low and scale-like 4–7 teeth ($n = 7$) (Fig. 12A). Fore wing with three submarginal cells.

Disc of T1 (Fig. 10D) basolaterally and apically with dense PP, and medially with sparse PP; IS weakly lineolate

on both basal half and apical margin, and nearly smooth on remaining area (IS = 1.0–3.5 d medially, = 0.5–1.5 d apically). Discs of T2–T4 (Figs 10D–E) with dense PP over entire surface; IS weakly lineolate on apical margin, and nearly smooth on remaining area (IS = 0.5–1.5 d). Submedial patch of T1–T3 distinct. Disc of T4 (Fig. 10E) distinctly convex medially, so its remaining part becomes depressed.

Description of male. Measurements (in mm; minimum–maximum (mean \pm standard deviation; $n = 5$). BL = 8.46–9.38 (8.97 \pm 0.31), WL = 7.43–8.43 (8.00 \pm 0.35), HL = 2.54–2.76 (2.65 \pm 0.08), HW = 2.63–3.05 (2.83 \pm 0.16), IOD = 0.39–0.46 (0.43 \pm 0.02), OOD = 0.59–0.70 (0.64 \pm 0.04), OCD = 0.54–0.70 (0.63 \pm 0.06), UOD = 1.74–2.07 (1.90 \pm 0.12), MOD = 1.78–2.09 (1.94 \pm 0.12), LOD = 1.76–2.07 (1.91 \pm 0.13), IAD = 0.37–0.43 (0.40 \pm 0.03), AOD = 0.48–0.57 (0.53 \pm 0.04), CAL = 0.43–0.52 (0.47 \pm 0.03), CPL = 0.63 (0.63 \pm 0.00), EL = 1.49–1.71 (1.63 \pm 0.09), EW = 0.60–0.76 (0.66 \pm 0.05), GW = 0.76–1.02 (0.90 \pm 0.09), SPL = 0.87–0.98 (0.92 \pm 0.04), F1L = 0.20–0.22 (0.21 \pm 0.01), F2L = 0.30–0.33 (0.31 \pm 0.01), F3L = 0.30–0.33 (0.31 \pm 0.01), F2W = 0.17–0.22 (0.20 \pm 0.01), MsW = 2.69–3.00 (2.78 \pm 0.12), SCL = 0.57–0.63 (0.62 \pm 0.03), MNL = 0.38–0.44 (0.40 \pm 0.03), MPL = 0.32–0.38 (0.36 \pm 0.03), MtW = 2.69–3.06 (2.84 \pm 0.12).

Coloration. Body black except for the following parts: mandible sometimes reddish or weak yellowish brown; tegula yellowish brown translucent; tibial spur yellow; metasomal terga narrowly yellowish brown translucent

apically. Wings nearly transparent (in paratype slightly brown), veins and stigma brown.

Pubescence. Body covered with erect and sparse straight or fine branched hairs except for the following parts: lower paraocular area, pronotum on dorsal area and around lobe, metanotum with moderately dense tomentose. Basal hair bands of metasomal terga present on T2–T3 or T2–T4 (Figs 11D–E) complete or incomplete. S6 with narrow linear hair tuft (Fig. 11F). Body mostly whitish, but weakly pale fulvous on mesoscutum to metanotum, and mixed with blackish hairs on T2–T3. T4–T6 mostly blackish.

Structure and sculpture. Head wider than long or nearly as long as wide; HW : HL = 1.00 : 0.94. Vertex rounded in frontal view. MOD : UOD : LOD = 1.00 : 0.98 : 0.99. IOD : OOD : OCD = 1.00 : 1.48 : 1.45. IAD : AOD = 1.00 : 0.75. Ocellular area with dense PP; IS smooth (IS = 0.5–2.0 d). Paraocular area and frons with reticulate PP. Supraclypeal area slightly convex, with dense PP; IS nearly smooth (IS = 0.5–1.5 d). CPL : CAL = 1.00 : 0.74. Clypeus nearly flat, with larger shallow PP, moderately dense on upper half, sparse on lower half; IS nearly smooth. EW : GW = 1.00 : 1.36. Genal area nearly smooth except for pores. Postgena nearly smooth. Malar space linear. Hypostomal carinae nearly parallel. Mandible edentate. Antenna short, not reaching metasoma. F2L : F2W = 1.00 : 1.58; flagellum nearly flattened ventrally.

Dorsolateral angle of pronotum obtuse; lateral surface with distinct ridge; lateral lobe rounded. Tegula ovoid, nearly smooth. Mesoscutum (Fig. 11B) with reticulate PP on anterior and lateral margin, and with dense PP on remaining area; IS smooth (IS = 0.5–2.0 d); parapsidal line narrow groove. Mesoscutellum with reticulate PP except for submedian area that is sparsely punctate; IS smooth on submedian area (IS = 1.5–4.0 d on submedian area). Metanotum rugulose. Mesepisternum coarsely rugulose over entire surface. SCL : MNL : MPL = 1.00 : 0.64 : 0.58. Propodeum: metapostnotum (Fig. 11C) gently inclined, with longitudinal ridges reaching posterior margin, nearly smooth among ridges; junction between metapostnotum and posterior surface not carinate; lateral and posterior surface coarsely rugulose; posterior surface with complete lateral carina, and without oblique carina. Coxae of usual shape, without tubercle. Fore trochanter narrow, longer than wide. Basitibial plate of hind leg carinate marginally. Inner hind tibial spur without distinct teeth. Fore wing with three submarginal cells.

Disc of T1 (Fig. 11D) basally with sparser PP, and medially to apically with denser PP; IS smooth (IS = 2–6 d basally, = 1.0–2.7 d medially to apically). Discs of T2–T4 (Figs 11D–E) with dense PP over entire surface; IS very weakly lineolate on apical margin, nearly smooth on remaining area (IS = 1.0–2.5 d). Submedial patch of T1–T5 slightly convex. T7 (Fig. 11E) with well developed lateral projection that exceeds tip of T7. S7–S8 (Fig. 12B): S7 with short and narrow median process; S8 without median process.

Genitalia (Figs 12C–D). Gonobase flat at bottom, ventral arms not connected with each other at upper ends; gonocoxite smooth; gonostylus spatulate, with sparse short hairs.

Etymology. The specific name is derived from its similarity to *L. inoum*; adjective.

Flight records. Female: March to May and July to October. Male: June to July and September to October.

Distribution. Taiwan.

Predicted range of the three Taiwanese *Leuchalictus* species

The current study has confirmed three *Leuchalictus* species in Taiwan which exhibit some degree of spatial segregation in their elevational distribution ranges. The analysis using Maxent to predict the distribution of each species showed that *Lasioglossum formosae* and *L. subopacum* are generally predicted in lowlands or low mountainous areas near the central mountains (Figs 5, 9). *Lasioglossum subinoum* sp. nov., on the other hand, is mainly a high-altitude species predicted in or near the highlands of the central mountains (Fig. 13). Actually, *L. formosae* usually inhabits the lowlands and low mountainous areas below 1,000 m a.s.l., while *L. subopacum* has a similar range but can be found at elevations exceeding 2,000 m a.s.l. In lowland areas, *L. formosae* is frequently observed, and it is able to adapt to urban environments such as city parks and heavily disturbed green spaces. In contrast, *L. subopacum* prefers open areas with well-developed forests or woodlands nearby. However, based on the examined specimens, it seems that the two species can coexist in urban areas at low mountains and may even be found together at the same site.

Species excluded from the Taiwanese fauna

YASUMATSU & HIRASHIMA (1965) were the first to report *Lasioglossum* (*Leuchalictus*) *occidens* in Taiwan, based on a male collected from Rimogan (now Fushan village in Wulai, New Taipei City). However, since then, there has been no further record of this species in Taiwan. Although the male specimen recorded by YASUMATSU & HIRASHIMA (1965) was thought to be preserved in ELKU, we were unable to find it. Additionally, despite examining many specimens of Taiwanese *Lasioglossum*, preserved in different collections and collected during field surveys, we were unable to find any specimens of *L. occidens*. Therefore, we consider the report of *L. occidens* by YASUMATSU & HIRASHIMA (1965) to be a misidentification.

As previously mentioned, *L. subinoum* sp. nov. is consistent with the *L. inoum* previously recorded in Taiwan by MURAO (2015).

Key to the species of *Lasioglossum* (*Leuchalictus*) in Taiwan

- | | |
|--|---|
| 1 Females. | 2 |
| – Males. | 4 |
| 2 Pronotal dorsolateral angle projected and acute (Fig. 6B); mesoscutum with anterior edge reflexed upward, medio-anterior area with punctures forming dense transverse ridge; T1 basally with dense, thick tomentum (Fig. 6D). | |
| | <i>L. subopacum subopacum</i> (Smith, 1853) |

- Pronotal dorsolateral angle not projected, rather obtuse (Figs 2B, 10B); mesoscutum flat and punctate or reticulate punctate on medio-anterior margin; T1 without tomentum as in Figs 2D, 10D. 3
- 3 Vertex long, OCD approximately 2.8× diameter of ocelli; genal area longer than eye width, GW approximately 1.2–1.4× EW; mesoscutum anteriorly with reticulate PP, but not coarse; metapostnotum with longitudinal ridges (Fig. 10C); disc of T1 medially with sparser PP as in Fig. 10D (IS = 1.0–3.5 d); T4 distinctly sloped on medial to apical area (Fig. 10E).
..... **L. subinum sp. nov.**
- Vertex short, OCD approximately 2× diameter of ocelli; genal area shorter than eye width, GW approximately 0.8–0.9× EW; mesoscutum anteriorly with coarse reticulate PP; metapostnotum with reticulate ridges (Fig. 2C); disc of T1 medially with denser PP as in Fig. 2D (IS = 0.5–1.5 d); T4 flat (Fig. 2E).
..... **L. formosae** (Strand, 1910)
- 4. Vertex long as in female, OCD approximately 3.8× diameter of ocelli; clypeus black, without yellow spot (Fig. 11A); genal area longer than eye width as in female, GW approximately 1.1–1.6× EW; T1 medially with sparser PP as in Fig. 11D (IS = 1.0–2.7 d); T7 (Fig. 11E) with well developed lateral projection that exceeds tip of T7; hair tuft on S6 elongate (Fig. 11F).
..... **L. subinum sp. nov.**
- Vertex short, OCD approximately 1.9× diameter of ocelli; clypeus with yellow spot on lower half (Figs 3A, 7A); genal area shorter than eye width, GW approximately 0.7–0.8× EW; T1 medially with denser PP as in Figs 3D, 7D (IS = 0.5–1.5 d); T7 without distinct lateral projection; hair tuft on S6 broad Ω shaped (Figs 3E, 7E)..... 5
- 5. Mesoscutum with anterior edge reflexed upward; T1 basally with moderately dense, thin tomentum.
..... **L. subopacum subopacum** (Smith, 1853)
- Mesoscutum flat; T1 without tomentum.
..... **L. formosae** (Strand, 1910)

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